

SECRET

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20 March 1964

MEMORANDUM FOR THE RECORD

SUBJECT: Inspection and Acceptance Report of [REDACTED] 3X, 6x,
12X Enlarger.

1. The 3X to 12X Precision Enlarger developed by [REDACTED] was delivered to NPIC, PSD/PLB, on 12 November 1963 and was installed by [REDACTED] the following week. A number of difficulties such as burnt-out fuses, diodes and switches were corrected. The film transport, however, did not work and [REDACTED] said that he would return to fix it. I understand that he did return, but I was not informed of his presence, and when I next saw the enlarger, the transport, if ever corrected, was again out of order. In as much as personnel in the Photographic Laboratory appeared to be of the opinion that personnel of the P&DS were not required in the check-out of the enlarger, no further attempt was made to check out the item until an understanding of responsibilities was established between the Chiefs of the Laboratory and the Development Branch on 2 January 1964. A systematic inspection was begun on 6 January 1964.

2. The specifications, dated 10 January 1962, which were incorporated as a part of the Contract [REDACTED] contained the following technical requirements.

a. The design of the enlarger shall be such as to accept roll film negatives from 70mm to $9\frac{1}{2}$ " on standard Air Force spools up to 10" in diameter.

b. The lens will cover a negative format of 70mm square and will have a resolution capability at the negative of:

- (1) 180 lines per millimeter high contrast.
- (2) 130 lines per millimeter medium contrast.
- (3) 85 lines per millimeter low contrast.

c. The negative transport will be designed to operate manually without any physical damage to the film, such as scratches or abrasions. The design will permit moving the film transverse to the roll a sufficient distance to expose a 70mm x 70mm area of a $9\frac{1}{2}$ " wide film at either edge of the film width. Other film widths such as 5" and 7" will be equally accommodated.

- d. The basic design is to be either horizontal or verticle, depending upon the focal length of the selected lens.
 - e. The magnification range will be continuously variable from three diameters to twelve diameters.
 - f. Critical focusing is to be accomplished by the use of a "Focatron" meter to be furnished by the purchaser.
 - g. The negative plane, lens plane and easel plane are to be parallel to within three (3) minutes of arc throughout the entire magnification range. (Two of the planes are to be moveable, the third plane will be fixed.)
 - h. The easel will be of the vacuum type with sufficient vacuum to hold flat a sheet of cut film or paper, 42" x 42", in a horizontal position without cover glass.
 - i. The illumination system will be a high-quality condenser-focused system using a light source having a wave length best suited to the selected lens. The maximum required exposure time for a negative having a D Max. of 3.40 at an enlargement of 12X shall not exceed 30 seconds on Kodabromide #2 or equivalent material.
 - j. The focal plane will be an optically flat glass, and at this point, the heat from the light source will not cause a temperature rise of more than 20°F above the ambient temperature with the film stationary for at least two minutes.
 - k. The enlarger will have a built-in timer having a range of from 0 to 60 seconds which will activate a shutter or light switch depending on the type of light source used.
 - l. The enlarger will be equipped with leveling screws and vibration dampening mounts.
 - m. The blower, if required for the light source, will be mounted remote to the enlarger.
3. Upon recommendations of the contract monitor, the film transport was changed from manual to electrical; the 105mm Schneider lens (Government furnished) was selected as the most suitable lens; and the light source, wave length matched to the lens, to an accommodation of four different sources to be interchanged at will. A vertical configuration was selected as the most desirable method.

4. Conformance of delivered equipment with specifications:

a. The enlarger will accept roll film negatives from 70mm to $9\frac{1}{2}$ " on standard Air Force spools.

b. The lens will cover a negative format of 70mm square. The obtainable resolutions shown below are much lower than the specified 180 lines per millimeter. Because of the low resolution readings obtained, no measurements were made on other than high contrast targets.

Resolutions obtained using standard Air Force resolution target at 12X magnification and 500 watt lamp:

Front left area of easel	113 l/mm
Front right area of easel	91 l/mm
Rear right area of easel	113 l/mm
Rear left area of easel	113 l/mm
Center area of easel	113 l/mm

Resolutions obtained using 12X magnification and ultra-violet lamp:

Front left area of easel	90 l/mm
Front right area of easel	113 l/mm
Rear right area of easel	113 l/mm
Rear left area of easel	113 l/mm
Center area of easel	57 l/mm

Resolutions obtained using 12X magnification and concentrated arc lamp at 3 amps exposure $\frac{1}{2}$ second.

Front left area of easel	113 l/mm
Front right area of easel	113 l/mm
Rear right area of easel	81 l/mm
Rear left area of easel	113 l/mm
Center area of easel	113 l/mm

c. It was not possible to perform tests on the negative transport because the power drives are not and have not been working since the enlarger was delivered. It is possible to project a 70mm x 70mm area from any selected area on any of the films from 70mm to $9\frac{1}{2}$ " in width.

d. The basic design of the enlarger is vertical. However, the workmanship is so poor that one can never be sure of quality, "good results. There is "lost" motion between the enlarger-head support arm and the vertical column which permits major amounts of tip, tilt and sway of the enlarger head.

e. The magnification range is continuously variable from 3X to 12X with automatic stops at 3-6 and 12X; to be accurate, however, the automatic magnification selection must always be made with the enlarger traveling in the upward direction.

f. Critical focusing is accomplished by means of a focusing cam attached to the vertical column. A rider on this cam couples to the lens focusing mount. It was not possible to check the lens for maximum focus because electrical surges in the room effected the focatron to such a degree that it could not be read. As in "e", above, accuracy is only obtained when enlarger head is traveling in the upward direction.

g. The negative plane, lens plane and easel are parallel to within three minutes of arc, with no film spools on the enlarger and the film carriage in the rearward position; this relationship is not maintained, however, when a loaded film spool is placed on the machine or when the film carriage is in the forward position for operation. Under these conditions, they are out of parallel by more than double the allowable 3 minutes of arc. This inaccuracy is almost all, if not entirely, due to the poor workmanship discussed in "d", above.

h. The easel does not have sufficient vacuum to hold even single weight paper in a horizontal position; the surface of the easel is made of some plastic material that is much too fragile. Damage has resulted from the accidental dropping of the spool spindle nuts. The surface of the easel should be white, not black, as in this case, for one cannot see to compose the image.

i. The illumination system has been changed as indicated in paragraph 3, above. The socket for the 500 watt lamp does not hold the lamp in a positive position nor is full freedom for adjustment provided for any of the lamps. The exposure required for a negative having a maximum density of 3.40 is less than 30 seconds on Kodabromide #2 paper.

The light distribution and intensity for the four different lamps is shown below. Dust trapped between the upper platen and the condensers dispersed the light beam from the concentrated arc to such a degree that measurement was difficult and inaccurate.

With the 500 watt lamp at dial position 80 or 4.1 amps and enlarger head at 12X magnification, the light readings at the easel were:

Front left corner	5.95 foot-candles
Front right corner	6.00 foot-candles
Rear right corner	6.95 foot-candles
Rear left corner	6.95 foot-candles
Center of easel	7.20 foot-candles

At 6X magnification at same current setting, the intensity and distribution is:

Front left corner	27.5 foot-candles
Front right corner	29.0 foot-candles
Rear right corner	33.0 foot-candles
Rear left corner	31.5 foot-candles
Center	32.5 foot-candles

At 3X magnification at same current setting, the intensity and distribution is:

Front left corner	105.0 foot-candles
Front right corner	105.0 foot-candles
Rear right corner	115.0 foot-candles
Rear left corner	115.0 foot-candles
Center	115.0 foot-candles

With the 150 watt lamp burning at full voltage (115), approximately 1 amp and enlarger head at 3X magnification, the light readings at the easel were:

Left front corner	23 foot-candles
Right front corner	24 foot-candles
Right rear corner	26 foot-candles
Left rear corner	26 foot-candles
Center	25 foot-candles

With the 85 watt ultra-violet lamp burning at full voltage (115) and enlarger head at 6X magnification, the light readings at the easel were:

Left front corner	1.6 foot-candles
Right front corner	1.6 foot-candles
Right rear corner	1.6 foot-candles
Left rear corner	1.6 foot-candles
Center	1.8 foot-candles

With the 100 watt concentrated arc lamp burning at 5 amps and the enlarger head at 6X magnification, the light readings at the easel were:

Left front corner	1.45 foot-candles
Right front corner	1.45 foot-candles
Right rear corner	1.50 foot-candles
Left rear corner	1.50 foot-candles
Center	1.50 foot-candles

j. The focal plane or platen glass was measured by means of bi-refringent light and was found to be out of parallel by as much as 1 minute of arc. The method used in mounting the upper platen glass makes it impractical to clean either this glass or the condensers. It was not possible to read the temperature rise at the platen because our Thermo-meter is out of working order and is not known when the required parts will be received.

k. The built-in timer has a range from 1/10 second to well in excess of one minute, and is used to actuate a shutter at the lens. The 1/10 second time is of no value, however, because it takes at least $\frac{1}{2}$ second to actuate the shutter.

l. The base of the enlarger is equipped with effective leveling screws and vibration dampening mounts.

m. The blower for cooling the lamp house is mounted remotely to prevent introducing of vibration to the enlarger head. The master switch, which controls this blower, is mounted on the control panel. No provision has been made to automatically cut off the blower during the exposure as was requested by the contract monitor.

5. Discussion:

a. The 3-6-12X enlarger was developed under rather broad specifications with the intention that the item produced would be a precision enlarger. The item delivered, however, cannot be considered a precision instrument. The resolution obtained is only about 50% of the intended goal.

b. The enlarger head does not have the rigidity and accuracy of position or freedom from vibration that is required for a precision instrument.

c. The film transport is very poorly designed; the spindles are too weak to carry a fully loaded spool of film without bending and would generate much vibrations.

d. The electrical circuits are not adequate to give reasonably trouble-free operation. Fuses and other means used to protect over-loading of the circuits are not readily accessible.

e. Access to the film gate, the upper platen glass and the condensers is inadequate for a precision instrument.

f. The vacuum system for holding material on the easel is inadequate.

g. The light distribution is inadequate with all of the four light sources and proper adjustment of the lamp envelop is not provided.

h. Attached as enclosure (1) is a list of the enlarger faults which the personnel of PSD/PLB intend to discuss with [REDACTED] on their own initiative for possible solution.

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6. Conclusions:

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a. The 3-6-12X enlarger, as built by [REDACTED] cannot be considered a precision enlarger. Modification of the deficiencies is considered to be neither practical or economical.

b. In as much as the lens used on this enlarger is Government furnished equipment, it is doubtful that the manufacturer can be required to meet the resolution requirements stated in his specifications.

c. It is further doubtful that the manufacturer can be held responsible for the poor design of the equipment, in light of the many changes made during development at the request of the many contract monitors that worked with the manufacturer during the development.

7. Recommendations:

a. Accept the enlarger in its present state (with such repairs to the components that are out of operation). [REDACTED] will agree to make these at no additional cost to the Government.

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b. Inform the Photographic Laboratory that the enlarger does not meet the technical requirements laid down for its development, but that further modification of the enlarger is considered to be impractical. Further, that the item is now entirely in their custody for such use, if any, that they may care to make of it to include responsibility for maintenance, if any.

c. Furnish Logistics with an inspection report advising them that the item does not meet either the technical requirements or the specifications prepared by the manufacturer and that the item is poorly designed and cannot be considered "precision" in any sense of the word. But, in light of the Government furnished lens and advice furnished the manufacturer during the development by Government representatives, we believe it would be most difficult to hold the contract in technical default. Therefore, it is suggested that the contract be terminated.

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[REDACTED]
Development Branch, P&DS

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SUGGESTED MODIFICATIONS

Listed below are some of the changes that I would suggest to improve this machine and bring out its maximum.

1. The pressure glasses are difficult to clean. The bottom glass is next to impossible to clean and the condensers are impossible to get at and clean.
2. Easel surface should be white. Presently it is black and the projected image cannot be seen without using a model sheet.
3. The vacuum on the easel isn't powerful enough even for single weight in some cases.
4. Film spindles are not sturdy enough. When nine inch rolls are put on machine the spindles bend down. This has caused them to warp.
5. Film spindle locks are needed. Presently the spindles are threaded on the ends to secure the rolls. This is bad, because every time a roll is put on and removed from the machine it drags across the threads. This has ruined the threads. I think a flip-type lock, such as on movie projectors, would solve this problem.
6. Access to film plane. In order to remove the pressure glasses, clean the glasses, inset an overlap or any other transaction at the focal plane the light source has to be raised and propped open by a piece of wood. I should think that a counter-balance or a lock could be installed to correct this problem. While this is propped open it has a good chance of falling down and shattering the glass or doing any other multiple of things to damage the machine.
7. Film drive motors are not strong enough. When film is advancing in either direction, and it nears the center of the roll, it slows down almost to a complete stop and creeps to the end of the roll.

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8. Film drive and spindles should be rounded on bottom half of machine rather than the top where they presently are. When there is a nine inch roll on the machine it is quite difficult to raise the light source because of all the weight having to be lifted. If it was mounted below, all that would have to be lifted would be the lamp housing.
9. A swing filter should be mounted under the lens.
10. Incorporate the use of a viewing light box for the inspection of film prior to its exposure.
11. Check the possibilities of a counter system.
12. Relocate the electrical fuse panel to the outside of the enlarger base. Preferable the right side of this base.